CORRES CONTROL
INCOMING LTR NO

02263 RF 94

DUE
DATE

ACTION

DIST.		ENC
BERMAN, H S		
CARNIVAL, G J		
COPP, R D		
CORDOVA, R.C.		
DAVIS, J G		
FERRERA, D W		
FRANZ, W A		
HANNI, B J		
HEALY, T J		
HEDAHL T G		
HILBIG J G		
HUTCHINS N M		
KELL R E		
KIRBY W A		
KUESTER A W		
MAHAFFEY J W		
MANN H P		
MARX G E		
McKENNA F G		
MORGAN R V		
PIZZUTO V M		
POTTER G L		
SANDLIN N B		
SATTERWHITE D G		
SCHUBERT A L		
SETLOCK G H		
STIGER S G	X	
SULLIVAN, M T		
SWANSON, E R		
WILKINSON R B		
WILSON J M		
Hopkins J	X	
Busby W	X	
Houk R	X	

CORRES CONTROL		
ADMN RECORD/080	X	2
PATS/T130G		

Reviewed for Addressee
Corres Control RFP

6/3/94 Cm
DATE BY

Ref Ltr #

DOE ORDER # 5400.1

RF-46522 (Rev 01/94)

Department of Energy

ROCKY FLATS OFFICE
P O BOX 928
GOLDEN COLORADO 80402-0928

JUN 0 1 1994

94 DOE 06112

000030971

Mr Martin Hestmark
U S Environmental Protection Agency Region VIII
ATTN Rocky Flats Project Manager 8HWM RI
999 18th Street Suite 500 8WM C
Denver Colorado 80202 2405

Mr Gary Baughman
Hazardous Waste Facilities Unit Leader
Colorado Department of Health
4300 Cherry Creek Drive South
Denver Colorado 80222 1530

Gentlemen

Enclosed is a draft discussion/rational concerning the initial screening of bioremediation for the Corrective Measures Study/Feasibility Study (CMS/FS) at Operable Unit No 1 In a meeting held May 13 1994 we indicated that this draft discussion would be provided to your respective staffs within two weeks This discussion will be added to the information presented in Technical Memorandum No 11 Development and Screening of Remedial Action Alternatives and in the CMS/FS report

Please contact Scott Grace of my staff at 966 7199 if you have any questions

Sincerely

Jessie Roberson
Acting Assistant Manager for
Environmental Restoration

Enclosure

cc w/Enclosure
A Rampertaap EM 453
J Ciocco EM 453 1
F Lockhart ER RFFO
S Grace ER RFFO
T Reeves ER RFFO
J Hopkins EG&G
W Busby EG&G
R Houk EG&G
J Swanson CDH
G Kleeman EPA

cc w/o Enclosure
M Silverman OOM RFFO
L Smith OOM RFFO

ADMIN RECORD

BIOREMEDIATION AT OU 1

Description

Two in situ bioremediation technologies were originally identified as potentially applicable at OU 1 The methanotrophic co metabolism option relies on methylotrophic bacteria organisms which utilize compounds containing a single carbon atom as their nutrient source These bacteria produce a group of enzymes called methane monooxygenases which breakdown methane molecules into compounds usable by the organisms These group of enzymes also degrade or co metabolize trichloroethene (TCE) trichloroethane (TCA) and other halogenated organics at rates much faster than typical aerobic processes These enzymes however have exhibited no effectiveness in increasing degradation rates of tetrachloroethene (PCE)

Another in situ bioremediation technology originally identified as potentially applicable at OU 1 involves aerobic degradation with the addition of hydrogen peroxide as both an oxygen source and as a free radical catalyst for oxidation of contaminant compounds (Lagrega Buckingham and Evans pg 597) The introduced hydrogen peroxide concentration is typically limited to approximately 100 to 500 mg/L due to toxic effects on the microorganisms Hydrogen peroxide is injected along with other biologically mediated degradation processes which require large amounts of oxygen

Effectiveness

The effectiveness of bioremediation at the 881 Hillside is limited by the nature of the contaminants identified at OU 1 Although laboratory studies have shown up to 90% reduction of TCA and TCE concentrations under ideal conditions researchers remain skeptical as to the full scale applicability of this technology under field conditions stating that implementation of biodegradation of chlorinated hydrocarbons in field situations may be limited by the toxicity of high concentrations of these compounds to microorganisms and by the slow rate of degradation possible (Baker and Herson pg 223) In addition PCE a major OU 1 containment is a highly refractory compound for which there is no established field method for degradation (at rates which make treatment practical)

In addition bioremediation has no proven effectiveness on inorganics leaving selenium unaffected by the bacteria An aboveground treatment system could be utilized to remove selenium from extracted groundwater however this would most likely limit the effectiveness of any reinjection systems designed to recycle nutrients or non indigenous bacteria

Finally the range of contaminants to be remediated may require the use of multiple strains of bacteria forcing competition for nutrients and increasing the complexity of the subsurface system Optimal growth conditions would be difficult to control uniformly due to the heterogenous geology at the hillside and the lack of available water

Implementability

Site conditions at the 881 Hillside seriously limit the technical implementability of bioremediation at OU 1 The largest concern regarding implementation of bioremediation at OU 1 involves fluid circulation The Phase III RFI/RI clearly demonstrates the lack of a consistent defined water source beneath IHSS 119 1 Well and borehole data in the area have typically varied with regard to water table levels and saturated zones Implementation of bioremediation at OU 1 would require injection of large volumes of water in order to provide nutrients and/or non indigenous bacteria to treatment zones This may actually mobilize and spread contamination and may cause severe slumping at the hillside Experience at the hillside with installation of the French Drain has indicated that slumping is a serious concern under unsaturated conditions let alone under the highly saturated conditions that would be required for implementation of bioremediation

In addition the hillside is primarily composed of clay claystone and gravely clay especially in the area of IHSS 119 1 where the majority of the contamination is believed to originate Clays have low hydraulic conductivities and small pore spaces making nutrient and oxygen dispersion evenly through contamination zone extremely difficult and uncontrollable The variable soil moisture at the site may inhibit microbial growth or even kill off bacteria populations should the moisture content fall too low Factors such as pH temperature and Total Dissolved Solids (TDS) influence microbial growth and would be very difficult to control due to lack of open pore spaces and the lack of a defined groundwater pool

Cost

Although O&M and capital costs are not usually high for this form of treatment the inclusion of inorganic contaminants such as selenium would warrant additional unit processes which are not part of a typical biotreatment system If this technology was implemented aboveground then the capital costs incurred would be very high when compared to those associated with any existing on site systems (e g the UV/peroxide treatment system) If the technology was implemented in situ then additional aboveground treatment would be required regardless to remove inorganic contaminants in which case it would still be more cost effective to treat extracted groundwater through the existing system in the first place